

Oregon Agricultural College Experiment Station

The Rise, Development, and Value of the Agricultural Experiment Station

By

JAMES T. JARDINE

Director of Oregon Station



CORVALLIS, OREGON

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*On leave of absence.

The Rise, Development, and Value of the Agricultural Experiment Station

HOW SCIENCE CAME TO AGRICULTURE

"Only those above average in capabilities, those who produce more than average crop yields, and breed better than average livestock, get ahead."

This statement of Henry Jackson Waters, nationally known leader in agriculture, applies to communities and states as well as to individuals.

Dr. Waters points out that agricultural conditions under which the children work are very different from those under which their fathers worked. The fathers got virgin land by homesteading or at low purchase price, and even while they mined the soil of its fertility, made money from increasing market value of the land. The children take the land at high valuation and must spend money to build up the soil that their fathers mined at a profit. They may have to absorb a decline in value of the land due to decreased production instead of receiving almost certain profits from increased values as their fathers did.

This need not mean that agriculture is going to the "bow-wows." Difficulties certainly, but with a growing population to feed from farm areas depleted by soil exhaustion, who, with a real vision, will continue a pessimist in respect to agriculture? Agriculture will advance, though not by following old methods and superstitions while other industries are making such progress as transportation has made in a generation, from the ox to the airplane.

A few extra bushels from better varieties or better practices in growing the crops, a little gain from better animals and better and cheaper combinations of feeds, an added quantity and quality of produce from protection against crop pests, are what often place a farmer, community, or state in the upper third and make possible a profit not realized by average production.

SCIENCE ADDS TO PROFITS

"I'll give a million dollars to any man who will show me how to decrease the cost of a ton of steel ten cents," is a statement attributed to Andrew Carnegie—and Mr. Carnegie was a business man.

"If you can develop a rust-resistant wheat or oats, Congress could afford to give you a million dollars."—Gilbert N. Haugen, Chairman of Committee on Agriculture, House of Representatives, 67th Congress.

Suppose \$100,000 dollars annually was given to any person or agency that would show how to increase the yield of wheat in Oregon **one** bushel per acre without added cost of production. Would it pay? One bushel an acre would mean 1,102.375^① bushels annually on Oregon's 1921 wheat acreage—more than a million dollars clear velvet.

Some such returns on their investment was in the minds of the group of farmers who started the first organized agricultural experiment station in 1852, as related in an article written before 1875.^②

^① Figures from estimates of F. L. Kent, Agricultural Statistician, Bureau of Markets and Crop Estimates, Dept. of Agric.

^② Atwater, W. O. Agri. Exp. Station in Europe Rpt. U. S. Dept. of Agric. 1875.

FARMERS BACK NEW POLICY

"About the middle of the last century, a lighthouse, known as the Dunston Pillar, was built on the Lincoln Heath, in Lincolnshire, England. It was erected to guide travelers over a trackless, barren waste, a very desert, almost in the heart of England; and long it served its useful purpose. The pillar, no longer a lighthouse, now stands in the midst of a fertile and rich farming region, where all the land is in high cultivation. For 25 years no barren heath has been visible, even from its top."

Superphosphate of lime is given as the chief means of effecting this transformation. Chemistry still further taught agriculture the use of slaughter-house and fisheries refuse—bones, flesh, and blood, till then a nuisance and menace to public health. The farmers, seeing the advantages of uniting science with practice, soon began generally to establish experiment stations "to make a regular business of discovery for the use of farming."

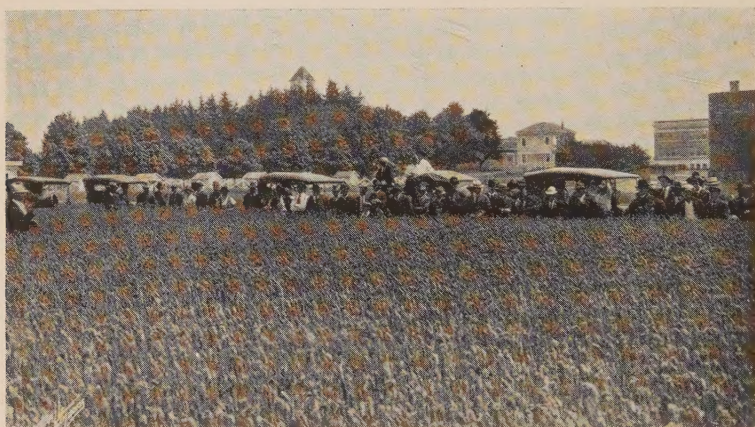


Fig. 1. Station field day: Farmers visiting the Experiment Station plots, Corvallis.

They formed associations and contributed lands, labor, buildings, cattle, and money as a means of making and saving money for themselves. Only by many careful experiments with records could they know positively how to save and use manure to grow crops cheaply, how to feed livestock to make meat, wool, and milk cheaply. The farmers lacked time and skill to conduct the experiments themselves, were not satisfied with the drippings of science from schools and colleges, and so united in support of their own well-springs of reliable information for their own use.

"They recognized the fact that science had developed the use of many valuable instruments of discovery—the thermometer, the microscope, the balance; that chemical analysis and the art of chemical investigation, which had given to the world phosphorus, superphosphate, chloroform, petroleum, electro-plating, and were to give chloral, the superb dyes of coal-tar, and an endless list of benefactions, were veritable engines of progress, and they determined to make full use of them. They saw, too, that the farm was not the place where these might effectually be put to doing farmwork,

and therefore, in the year 1852, a company of Saxon farmers, constituting the Leipzig Agricultural society, opened the first farmer's station for agricultural experiment at the little village of Moeckern, near the city of Leipzig.

"Moeckern was the first station where farmers themselves brought science to their own farms to aid them in their own farming. The example there given was so brilliant and solid that within two years another Saxon society, in the town of Chemnitz, set up a second station, and of the 22 years that have since elapsed, 1867 is the only one which has failed to witness the founding of one or more similar institutions in Germany or the neighboring countries. The experiment station shortly came to be regarded not as a costly embellishment or an agricultural luxury, in which universities or wealthy gentlemen might harmlessly indulge, but as a most remunerative and most necessary agency for the use as well as for the education of farmers."



Fig. 2. Increase rows of pure-line selections of grain varieties at the Moro Station. Hundreds of selections are made each year and from them higher-yielding wheats are eventually discovered.

About 80 such stations were established in Germany in the next 24 years. They were started and supported largely by farmers. The governments, becoming impressed with the value of such stations, came to their support and organized new ones. Early records list "agricultural societies, private individuals, neighboring cities, a railroad company, a bank, and even an insurance company, as well as governments, among contributors to the support of the stations.

The fact that the movement has continued, has grown and extended to other European countries, is proof of its value. As further proof Europe today, debt ridden as it is, is strengthening its agricultural experiment stations, its science in agriculture, realizing that all we now know is only a part of the real truth involved in the most complex of industries—agriculture.

THE UNITED STATES JOINS IN

About the time the farmers' agricultural station was established in Europe, far-seeing statesmen, educators, farmers, and men in the industrial pursuits of the United States were becoming concerned over the need of providing educational opportunities for those engaged in agriculture and the industries.^① "On April 2, 1850, the legislature of Michigan petitioned Congress for a donation of 350,000 acres of land for the establishment of an agricultural college in the state of Michigan. Massachusetts made a somewhat similar request April 20, 1852, for a grant of land in aid of a 'National Normal, Agricultural College.' The legislature of Illinois of February 8, 1853, petitioned Congress to donate 'to each state in the union an amount of public lands not less in value than five hundred thousand dollars, for the liberal endowment of a system of industrial universities, for the more liberal and practical education of our industrial classes and their teachers.'"

This movement was followed by the passage by Congress of the Morrill land grant act of 1862, donating land "to each of the several states for endowment, support, and maintenance of at least one college, where the leading object shall be, without excluding other scientific and classical studies and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts."

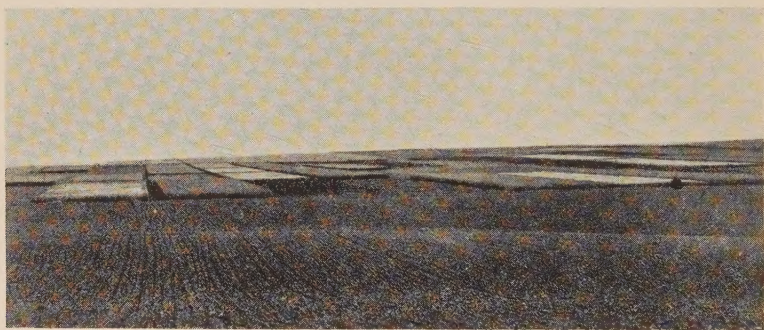


Fig. 3. Nine years' results at the Moro Station show that early plowing for summer fallow and cultivation to prevent weed growth mean three to six bushels increase in yield of winter wheat. Crop rotations in background.

AGRICULTURAL COLLEGES ESTABLISHED

The Morrill land grant act and subsequent Federal and state acts have resulted in the present state college of agriculture and mechanic arts. The people of Oregon through their legislature took advantage of the Federal act and established the Oregon State Agricultural College in 1868.

Like the others, O. A. C. was charged with the duty to teach; and considering the information or knowledge available, the teaching was well done. But it was soon apparent that without more knowledge the teaching of an industry so big, so varied and so complex as agriculture, could at best be little more than manual training in existing agricultural practices plus an awakening to the vast unknown in agriculture and an inspiration to find out.

^① James, Edward J. Univ. of Ill. Bul. Vol. IV; No. 1, Nov. 1910.

That the necessity for more than teaching modern practices was realized by Mr. Morrill is indicated by the following, given as one of his reasons for promoting the land grant act: "The very cheapness of our public lands, and the facility of purchase and transfer, tended to a system of bad farming, strip and waste soil, by encouraging short occupancy and a speedy search for new homes, entailing upon the first and older settlements a rapid deterioration of soil, which would not be likely to be arrested except by more thorough scientific knowledge of agriculture, and by a higher education of those who were devoted to its pursuit."

PLACE FOR INVESTIGATIONS NEEDED

So many questions of agriculture could not be answered without more "thorough scientific knowledge" that a few of the states early found a way to do a little research and investigating at the agricultural colleges. The first agricultural experiment station was started at Wesleyan University, Middletown, Connecticut, in 1875. These ventures were successful and

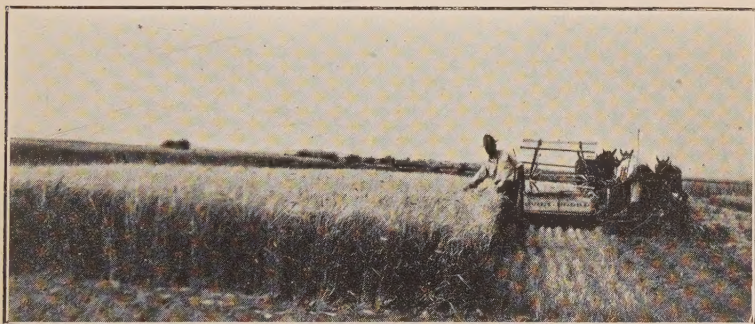


Fig. 4. Hannchen barley, the standard spring barley for Oregon. Tested and introduced by the Experiment Station.

profitable as they had been in Europe. But they were too limited in number and finances to cope with the growing needs of agriculture for the solution of its problems.

NEED MET BY STATE AGRICULTURAL EXPERIMENT STATIONS

The marked success and value of the many agricultural experiment stations in Europe and of the few in the United States, enlisted men of vision and courage in the work of furthering the experiment stations, assigning to them in coordination with the Federal Department of Agriculture the work of research and experiment for the benefit of the nation's agriculture. By 1887, Congress, recognizing the need as one of importance to the nation as well as to the several states, passed the Hatch agricultural experiment station act, giving to each state and territory \$15,000 a year from the national treasury for the maintenance of an agricultural experiment station and providing, except in a few cases, that these stations should be located at the agricultural colleges established under the land grant act of 1862.

AIM IS LEARN, NOT TEACH

In contrast with the **teaching function** of the agricultural colleges as specified in the land grant act of 1862, the purpose and work of the experiment stations, as outlined in the Hatch act, is to gain knowledge. The stations are to conduct original researches or verify experiments on the physiology of plants and animals—the diseases to which they are severally subject, with the remedies; the chemical composition of useful plants; the comparative advantages of rotation farming; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese, and other needed investigations, having regard to the varying conditions and needs of the respective states.



Fig. 5. O. A. C. No. 7 winter barley. Highest yielding winter barley for Western Oregon. Developed at the Experiment Station in 1909.

SIX FACTS TELL THE STORY

From this brief history, the following important facts about agricultural experiment stations are gathered:

First, they represent a cooperative venture which had its beginning about 70 years ago as an investment "to make a business of discovery for agriculture."

Second, their purpose is to secure facts which will answer questions and solve problems confronting agriculture now or expected to give trouble in the near future.

Third, the state stations were established by the Hatch act 25 years after the land grant act providing for agricultural colleges. They were not to take the place of the college as a teaching agency but to gather facts to make teaching and agricultural practice more effective.

Fourth, as the need grew for teaching away from the colleges in the several states the extension service was established for this purpose.

Fifth, the experiment station stands, in relation to the original teaching unit—the agricultural college—and to the extension service, as the fact-gathering agency, keeping up a bank account of facts to be checked out by resident teaching and extension service for the benefit of students, farmers, and all the people.

Sixth, almost from the beginning the agricultural experiment stations have been public institutions supported in whole or large part by public funds, because of their intimate and important relation to agricultural development and progress, which are fundamental to the welfare of all classes of people and of the nations.

PUBLIC SUPPORT GIVEN FOR TWO REASONS

Public support has been given for at least two important reasons. First, all people are concerned with the problem of adequate, suitable food supply. City people are most concerned since they rely upon the

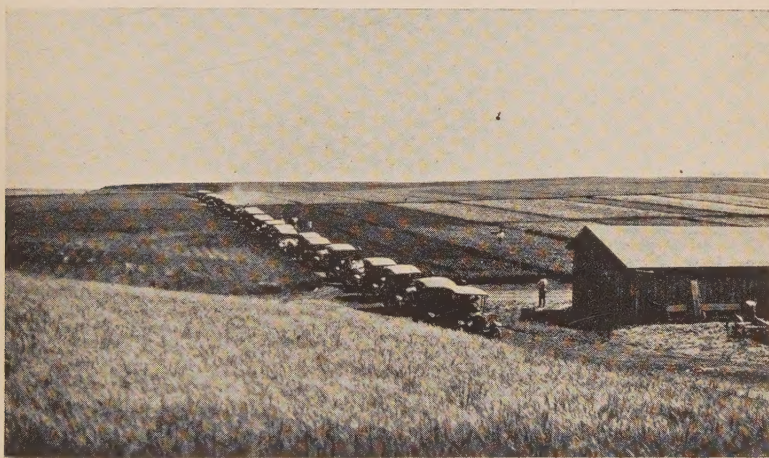


Fig. 6. Visitors at the Moro Station on Farmers' Day, June 25, 1921.

surplus the farmer does not need for family use. Second, nearly one hundred years of results and experience prove that scientific research is indispensable to agriculture if such troubles as Texas fever, blackleg, citrus canker, codling-moth, and wearing out of soil are to be overcome, as they must be to maintain food supply. Research for other industries leads to discoveries which can be patented or copyrighted and sold by the individual or group of individuals for a period of years. Agriculture is different. A new high-yielding crop, a new method of combating a disease of animals or plants, a better tillage or crop rotation cannot be patented or controlled by the individual or group of individuals. As a consequence, the discovery of a high-yielding wheat, which means millions of dollars to the people as a whole, can mean but little to the scientist who discovers it. If such research is done at all, therefore, it must be done for the public welfare and at public expense.

STATION RESULTS ARE BIG FACTOR IN STATE AND NATIONAL DEVELOPMENT

As long as agriculture could advance into new areas with centuries of fertility stored up, there was little call for science in agriculture. Now, even the successful economic development of new areas is dependent upon better methods of using and maintaining fertility, better crops, better animals and security against hazards of climate, crop pests, and animal pests. Otherwise production does not warrant cost of development. Nearly a century of experience in Europe and the United States has demonstrated that research and experimentation are the basis of progress in this development, recognized as such the world over.

Much of the progress in agriculture made by the United States during the past thirty years has come from methods and practices developed by state experiment stations and the United States Department of Agriculture. As proof of this, attention need only be called to a few of many results without which our agriculture would be as antiquated as the ox cart compared with the automobile. How would the dairy industry thrive without the Babcock test, worked out by the Wisconsin station; the beef industry, without vaccines to prevent losses from blackleg, or without methods to control Texas fever; the hog industry, without the modern preventive for hog cholera; the fruit industry, without modern control methods for codling-moth, scab, blight, and other pests, or without the mass of information on pruning, fertilizers and cover crops, upon which successful orchard management depends? What of wheat growing deprived of Durum wheats, Turkey wheats, Marquis wheat, Kanred wheat, or without present methods of seed treatment to prevent smut?

All of these and many other useful findings came by way of the experiment stations and the Department of Agriculture through years of patient, systematic study and experimentation. It is a fact generally acknowledged that any one of many of these discoveries—blackleg vaccine, for example—is worth more in dollars and cents to the nation than the entire cost of the experiment stations.

OREGON EXPERIMENT STATION COVERS DIVERS CONDITIONS

The Oregon Agricultural Experiment Station was established under the Hatch act of 1887. In accordance with this act the headquarters and main station laboratories and most of the technical staff are located at the Oregon Agricultural College. The Station is one of three main divisions of the college work—Resident Teaching, Experiment Station, and Extension Service.

Oregon, however, is primarily an agricultural state, and in the early stages of its development. Few, if any, other states have greater diversity of conditions, from desert, on the one hand, to about 100 inches rainfall on the other; with extremely complex soils and many highly specialized industries; and with distance from large consuming markets demanding high quality products, if Oregon is to compete successfully, as it is doing, with similar products grown nearer such markets.

The state has at least eight agricultural regions more different agriculturally from each other than many other states are different from their neighboring states. Even to meet approximately the needs of these

separate regions a branch experiment station has been established in each of seven regions, not to duplicate the work of the Main Station but to supplement it by studying a few main problems in each region and by trying out and adapting findings of the Main Station and other stations in the different regions of the state.

The branch stations are at Astoria, Hood River, Moro, Hermiston, Union, Burns, and Talent.

EXPERIMENT STATION MAKES FOR EFFICIENCY

The first duty of the Oregon Station is to carry out for Oregon the work already outlined for agricultural experiment stations.

To do this it must find more efficient crops and animals to grow, more effective methods of eliminating animal and crop diseases and pests, develop better methods of soil management, including crops, drainage, cultivation, rotation, and fertilizers—in fact develop systems of agriculture best suited to the state, frequently under changing economic conditions, transportation, and competition from other producing localities. In recent years the stations have been asked to work out methods and standards for sorting, grading, and standardizing agricultural products, to secure reliable data on production costs, and to study problems of orderly marketing.

A secondary duty which takes a large part of the energy and funds of stations is to put the facts in various forms suitable for different needs and uses of the agricultural community and to assist extension workers' and farmers' organizations in getting these facts and applying them in practice. The Station is the bank of information drawn upon constantly by resident teaching, extension, organizations, individuals, and the press.

A third duty is to administer such laws as the fertilizer inspection and lime inspection acts, and to examine other commodities such as spray materials to protect the farmers against expenditures for useless, harmful, or adulterated products, and at the same time protect and encourage needed standard products by examination and approval in accordance with state and national laws.

The Main Station at Corvallis represents the entire state and the branch stations in problems of chemistry, plant diseases, control of insects, animal diseases, bacteriology, farm management, poultry husbandry, the main problems in horticulture, dairying, beef, sheep, and hog problems of Western Oregon, all soil surveys and feasibility surveys for the state, most of the drainage investigations of the state, and all problems of agriculture in the Willamette Valley. It has general direction of all station work of the state.

The Astoria Branch Station, established in 1913, is working mainly on problems of dairy production, farm crops, soil fertility, and drainage under coast conditions.

The Hood River Branch Station, established in 1913, in cooperation with Hood River county, works primarily on problems of the fruit industry, in controlling diseases and pests, and meeting problems of orchard fertility, pruning, irrigation, and general orchard management.

The Moro Branch Station, established in cooperation with the Federal Government in 1909, works almost wholly on problems of grain production under dry-land farming in the Columbia Basin.

The Hermiston Branch Station, established in cooperation with the Federal Government in 1909, works mainly on problems of establishing agriculture on sandy lands under irrigation.

The Union Branch Station, established in 1901, is responsible for all livestock feeding studies for Oregon east of the Cascades. It is working also on crop problems, and is starting on dairy production problems for Eastern Oregon.

The Burns Branch Station, established in 1911, is studying crop production problems under both dry-farming and irrigation for the Harney Valley and the millions of acres in central and southeastern Oregon.

The Talent Branch Station, established in 1911, is working mainly on problems of fruit production in Southern Oregon.

The branch stations conduct field experiments almost entirely, with only such laboratory work as is necessary for effective cooperation with the laboratories and technical staff at the Main Station. Without the Main Station at Corvallis, branch stations would have to maintain laboratories and a technical staff for many of their problems.

HOW THE STATION IS MANAGED

The Station is under the control and general direction of the President and the Board of Regents of the Agricultural College and subject to inspection and approval by the Federal Department of Agriculture in expenditure of Federal funds. All funds are paid out upon claims approved by the Director, the President, and designated members of the Board of Regents.

The personnel consists of a Director in charge of all work of the Experiment Station division, a branch station superintendent in charge of each branch station; department heads at Corvallis corresponding to subject-matter departments of the resident teaching staff (in all cases the same men)—animal husbandry, agricultural chemistry, bacteriology, dairy husbandry, botany and plant pathology, entomology, farm crops, farm management, horticulture, poultry, soils, veterinary medicine. Under the direction and supervision of these heads, other individuals working on many problems devote part or full time to experimental work.

Each year, and whenever necessary, the problems for investigation are decided upon after careful consideration of the agriculture of the state and the many legal restrictions on the use of both Federal and state funds. Each project is carefully planned and is approved by the Director. The budgets based upon the proposed program of work are approved by the President of the College.

HOW THE STATION IS FINANCED

The Station was established in 1887 under the Federal Hatch act, which provided an appropriation of \$15,000 annually. This appropriation has been continued to date, and in 1906 the Federal Adams act made provision whereby an additional \$15,000 of Federal funds is made available, with certain limitations on its use.

The state, according to the experiment station act, was to provide most of the land and funds for buildings. This was done, but only a small amount of state money was provided for conducting the experimental

work during the first 20 years. The early work was done almost entirely from Federal funds. From the first, the Experiment Station division has been financed by Federal funds and by special state appropriations separate entirely from the resident teaching, or original College unit, and later, has been financed entirely separate also from the Extension Service.

The amount of state appropriations has varied greatly. The funds available during the fiscal year ended June 30, 1921, for the entire Experiment Station division, and their sources, were as follows:

1. Home Station at Corvallis, Oregon:

State of Oregon:			
Agricultural Investigations ..	\$25,000		
Crop Pest Control ..	15,000		
Soils Investigations ..	7,500		
Dairy Investigations ..	7,500	\$55,000	
Federal Government:			
Hatch Act ..	15,000		
Adams Act ..	15,000	30,000	
Miscellaneous:			
Receipts from Fertilizer Inspection ..		750	
			\$85,750

2. Branch Stations:

State of Oregon:			
Eastern Oregon Station at Union ..	\$ 7,500		
Umatilla Station at Hermiston ..	3,000		
Sherman County Station at Moro ..	6,000		
Harney County Station at Burns ..	8,000		
Clatsop County Station at Astoria ..	3,000		
Southern Oregon Station at Talent ..	12,000		
Hood River Station ..	5,000	44,500	
Federal Government:			
Sherman County Station at Moro ..	4,500		
Umatilla County Station at Hermiston ..	3,000	7,500	
Oregon Counties:			
Hood River County ..		4,000	
Miscellaneous:			
Estimated sales Branch Stations:			
Eastern Oregon Station ..	5,000		
Harney County Station ..	1,000		
Sherman County Station ..	1,800		
Clatsop County Station ..	3,500		
Southern Oregon Station ..	1,600		
Umatilla County Station ..	305	13,205	69,205
			154,955

The Federal funds for branch stations and the receipts vary slightly from year to year. In the aggregate both slightly exceeded the foregoing budgeted items during the past year but will probably be less during the year beginning July 1, 1922. In addition, the Federal Department conducts certain work in cooperation with the Station, each party financing a given part which varies somewhat from year to year and at most is a small portion of the station investigations.

DO THE PEOPLE GET THEIR MONEYS WORTH?

A question frequently asked, and perhaps often in the minds of many who do not ask it is, "Do the people of the state get value received for what they spend on the experiment stations?" Those well acquainted with the work of the Oregon Experiment Station and the meaning of its results to agriculture answer without hesitation, "Yes; many times over. More in a single year, in fact, than the entire Station has cost to date." Most people, however, are not familiar with the work of the Station and the application of its results. To them the following examples will make clear why those who know say **yes**, without hesitation.

STATION RESULTS BROUGHT AT LEAST \$5,000,000 TO OREGON AGRICULTURE IN 1921

The value of accumulated station results, applied in producing the 1921 agricultural products of Oregon, might justly be estimated from five million to ten million dollars. The combined judgment of men who have been identified with agriculture throughout the state over a period of years, estimates a value of not less than \$5,000,000 in producing products valued at something over \$100,000,000, including farm crops, horticultural, dairy, and poultry products only. This value is distributed roughly as follows:

1. From the use of better farm crops introduced or developed, tested and recommended by the Experiment Station, and of improved methods of growing them	\$1,475,000
2. From the use of fertilizers, irrigation methods and drainage methods developed by the Experiment Station	1,000,000
3. From the use of methods developed by the Experiment Station for controlling crop diseases and pests	1,488,000
4. From the use of improved methods and improved varieties in fruit production, not including control of disease and insects	400,000
5. From the use of higher producing poultry stock	1,000,000
6. From the use of better methods of feeding and preventing losses of livestock developed by the Experiment Station	500,000

Since the Extension Service and Resident Teaching have had much to do with aiding in the application of these findings in practice, the same items may be included wholly or in part as accomplishments of these divisions. But without the results of the Station in these matters, the new crops and new methods and practices would not have been available to apply.

The estimates are approximate only, but they are conservative and they indicate the very definite relation of the Experiment Station to agriculture in the state. Such results, moreover, might well be expected because of Oregon's highly specialized agriculture and diverse conditions.

Wider application of station results would greatly increase their value to the state. For example, sulfur as a fertilizer applies to 100,000 acres of alfalfa in the state. The value included for this item is for only 16,000 acres upon which, according to our best information, sulfur is now used. The same comment applies especially to crop protection.

THE TOTAL ANNUAL STATE AND COUNTY APPROPRIATION COST IS BUT \$2 PER AVERAGE FARM

The total state appropriations for experiment station work in Oregon to date have not exceeded \$1,000,000, nor the Federal appropriations \$850,000. As shown, the total state and county annual appropriation for

1921 and 1922 is \$103,500 each year. The Station has received in these years about 26 cents of each \$100 taxes. If the farmers paid the entire bill it would amount to about \$2.00 for the average farm.

OREGON STATION RESULTS OF OUTSTANDING IMPORTANCE

The following items are given in part to show how the accumulated results of the station work helped agriculture by \$5,000,000 in 1921 and in part to indicate ways in which the Station helps by its main business of discovery for agriculture in the state. The items do not by any means make a complete list.

STATION RESULTS HAVE AIDED FARM CROP PRODUCTION Through the Introduction of New Varieties

In Western Oregon, Hannchen, O. A. C. No. 7, Tennessee Winter, and Oderbrucker barleys, introduced by the Main Experiment Station, have increased yield by 10 to 15 bushels per acre on about 9,000 to 10,000



Fig. 7. Grimm alfalfa, introduced by the experiment stations at Union and Burns, yields about one-half ton more per acre than local common varieties on about 26,000 acres in Eastern Oregon.

acres and have aided in the increase of 28.6 percent in acreage between 1909 and 1919.

The introduction and improvement of corn—Minnesota 23 and Minnesota 13—and the distribution of seed from the Main Station, have had much to do with the increase of 85 percent in the corn acreage of the state from 1909 to 1919, mainly in Western Oregon counties. These selections yield about one ton more an acre than the varieties replaced on about 10,000 acres.

Grimm alfalfa introduced by the stations at Union and Burns has proved to be hardier and a better yielder by about one-half ton an acre than the local common varieties for Eastern Oregon conditions. This variety is increasing in acreage as a consequence of station results and recommendations over a period of years. There are at least 26,000 acres upon which the one-half ton increase was secured in 1921. Assuming that the net increase in value per acre was only \$1.50, it would mean \$39,000.

On the Umatilla irrigation project about 80 percent of the crop revenue is from alfalfa. Station experiments over years and close cooperation with farmers have resulted in selection of highest yielding varieties and in securing a stand. Assistance likewise has been rendered in securing higher yielding corn, vegetables, and pasture mixtures. It is believed conservative to estimate the increase due to this work of years at three percent of the crop value for 1921 or about \$16,000.

The Astoria Station has shown that Pomeranian White Globe turnip yields two tons an acre more, and has better keeping quality and therefore a longer feeding period, than the cowhorn turnip formerly used, and that improved American purpletop rutabaga is the best producer by about four tons an acre. Peas and oats, vetch, and Japanese barnyard millet, have been introduced as soiling and hay crops and are a factor of great value to the dairy industry of the region.

The introduction of new vetches and the working out of more successful methods of securing stands of vetches and clovers in Western Oregon



Fig. 8. Hungarian vetch on Experiment Station plots. This new vetch has proved of outstanding value in station trials. It is very hardy, a good yielder, and thrives on cold, wet land. In addition, it is excellent bee pasture. Seed from sixty acres will be distributed to farmers in 1922.

are items mainly of importance from now on. Nevertheless increased returns from these betterments in 1921 were not less than about \$70,000.

Superiority of Huston wheat in experiments at the Main Station has led to an increase of about three bushels of wheat an acre on about 30,000 acres—a small item, yet involving 90,000 bushels of wheat.

The Moro Branch Station was established in 1909 to investigate problems of dry-land agriculture. Failures and low yields at that time were not uncommon. Today they are hardly known in the same sense. A Turkey wheat, Karkov, selected and tested for years at this station, showed an increase of eight percent in yield over the local Turkey wheat. It was distributed to farmers and about 2,500,000 bushels grown in 1921. An increase of only five percent in yield would mean about 125,000 bushels.

Through Early Plowing for Summer Fallow

Careful experiments over nine years have shown that early plowing for summer fallow increases wheat yields from three to six bushels an acre. These results apply to practically all of Eastern Oregon, where 667,000 acres were sowed to winter wheat in 1920. More than half the farmers in this region are now plowing from five to six weeks earlier than they did seven or eight years ago, before the station results were made known. It is confidently believed that as a result of this station discovery there has been at least a three-bushel increase over one-half the acreage of the Moro Station, aggregating at least 1,000,000 bushels.

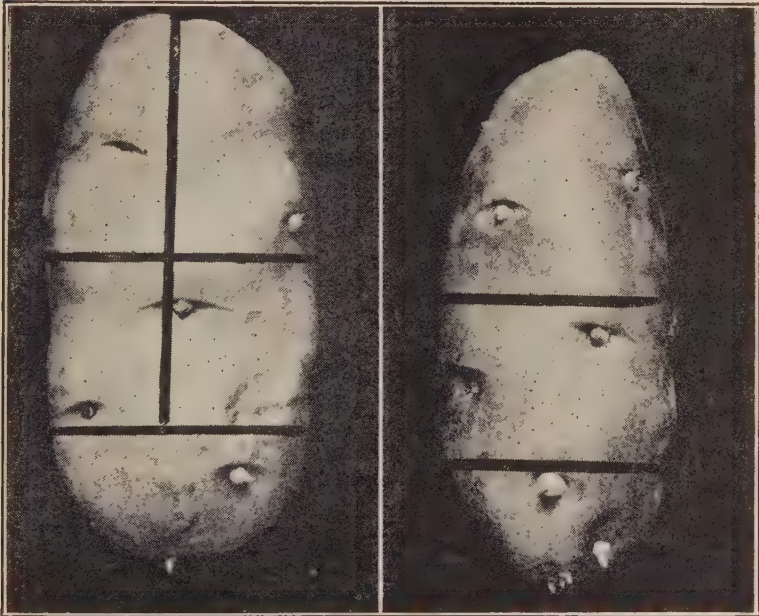


Fig. 9. An eight-ounce American Wonder potato cut correctly, to save the blossom-end piece. Left, edge view; right, flat view of potato after cutting.

Through Pure Strains of Seed

Forty-fold has been a popular wheat in Eastern Oregon for years. The Station at Union undertook to provide a pure strain Forty-fold to replace the common variety which had become badly mixed. This was accomplished, and in 1921 there was about 350,000 bushels of Forty-fold from this pure strain seed which sold as number 1 and number 2 wheat instead of mixed grade. The average increase in price was about six cents a bushel, or a saving of about \$21,000. Forty-fold is being replaced by other wheats selected and recommended by the stations. Meantime, however, this item shows another way in which the Station can render valuable service.

Through Improved Practices in Producing Potatoes

The results from experimental work on potato production have shown increase in production from better methods of cutting seed potatoes, from change in size of seed pieces, from hill selection for seed. These results are not in application yet over a large acreage, but information on what has been accomplished indicates an increased crop value of about \$40,000 in 1921 from application of the station findings.

Inoculation cultures for legumes are supplied to farmers of the state for 6,000 to 10,000 acres of legumes annually. The cultures, carefully prepared, fresh and vigorous, are supplied at twenty-five cents per acre, post paid, a saving of about \$1.75 per acre as compared with commercial prices.

SOIL FERTILITY, IRRIGATION, AND DRAINAGE EXPERIMENTS VITAL TO STATE'S AGRICULTURE

Too much or too little water, or deficiency in some element of soil fertility, alone or in combination, is frequently the limiting factor not only in successful crop production but in agricultural development.



Fig. 10. Effect of sulfates on alfalfa, Reimer plots, Southern Oregon soils experiment field. From 16,000 to 20,000 acres of alfalfa in Oregon was treated with sulfur in 1921 with an increase in yield of about one ton an acre.

The great amount of accurate data from station experiments on the amount of water required by different crops on different soils is a vital factor in planning irrigation development and in producing crops when the actual farming starts. The station results on drainage are also needed and in use daily in the development of the state. The great value of such results is difficult to estimate, as a whole, in dollars and cents. A number of examples, however, illustrate the close relation and importance of such work to the agriculture of the state.

Sulfur Has Increased Alfalfa Yield

Perhaps the station finding most widely known is the discovery in 1913 that sulfur as a fertilizer will increase yields of alfalfa on most of Oregon's alfalfa land. There are about 100,000 acres on which the yield of alfalfa can be increased at least one ton an acre by applying 100 pounds of sulfur every four years. From 16,000 to 20,000 acres were treated in 1921. The net increase in value was conservatively \$50,000.

Phosphate Has Increased Red Hill Soils

As a result of station experiments about 2000 tons of phosphate was applied as fertilizer in 1921 to about 20,000 acres of red hill soils in Western Oregon, resulting in a crop increase of about 25 percent. A net profit of \$2.00 an acre would mean a gain of \$40,000.

Other results on soil fertility are given for the fruit industry.

Economy of Irrigation Water Saves \$40,000 in a Year

In 1909 the Umatilla Branch Station was established to study problems of agriculture under irrigation on the sandy lands of the Umatilla project and other projects totaling about 275,000 acres. Water is the limiting factor in agricultural development on these lands, especially the Umatilla project. The average water used per acre in 1911 was 9.7 acre feet. Due largely to station work and results, the average amount in 1911 was reduced to 4.5 acre feet. If the project had continued to need and use 9.7 acre feet per acre, only about 60 percent of the present acreage could be supplied with water. The reduction in amount of water used at 75 cents per acre foot over the minimum charge means about \$40,000 saved in 1921 as compared with 1911. The reduction in water is due largely, or at least one-half, to improved methods of irrigation developed by the Station.

At the same time, new methods of preparing land for cropping and irrigation reduce labor costs of irrigation about one-half and the average costs of preparing land considerably. For the Oregon project alone in 1921, this meant \$10,000 at least.

These and other results of the Station have been of greater value than any estimates in developing successful crop production under difficult conditions to start with, and in helping to make productive fields from sandy waste.



Fig. 11. Drained field at Central Experiment Station. Heavy shock row limed and manured.

Over Two Hundred Farms Improved By Drainage

During the past few years tile drainage systems have been surveyed for 225 farms, which include 400 miles of tiling. These tiling systems have been largely placed, serving about 18,000 acres, upon which the increase in annual productive value is about \$10.00 an acre.

Sluicing Method Saves Big Money On Drains

During 1921 the Station assisted the people of Vale, Oregon, in developing an economical method for construction of deep drainage by sluicing. The saving on one drainage district alone as a result of this service, according to a Director of the District, O. E. Carman of Vale, has been \$25,000. The results of these experiments will lead to much needed drainage which otherwise would probably be indefinitely delayed and will save, according to Mr. Carman, perhaps hundreds of thousands of dollars.



Fig. 12. Drainage ditch twelve feet deep constructed by sluicing in experiments at Vale, Oregon in 1921.

Soil Surveys Promote Profitable Reclamation

Preliminary soil and agricultural surveys on over 3,000,000 acres have been made to assist in determining whether reclamation by irrigation and drainage is feasible. These surveys have helped to shape up the projects and establish the merits of reclamation. Of this area one and one-fourth million acres have been organized for reclamation and nearly \$18,000,000 of bonds voted.

The Station has furnished the information which is in use as to amount of water best for different crops and soils in the leading irrigation valleys of the state, and has shown that about one-half million acres of wild meadow and tule land can be doubled in production with one-half the water.

In addition, use is being made of information secured over years on rotations and methods of cultivation to maintain or help maintain soil fertility—a fundamental requirement of permanent agriculture.

STATION RESULTS MEAN MUCH TO THE HORTICULTURAL INDUSTRY

The Oregon Station is perhaps best known throughout the country for its work and results in meeting problems of the horticultural industry in the growing of fruit products, their protection against diseases and pests, and for its beginning on experiments with horticultural products and by-products.

Oregon Station Recognized for Far-Reaching Results in Pruning

Perhaps no one line of investigations has given more prominence than the work in pruning. Yet it would be difficult to estimate the value of results in dollars and cents. The Station is recognized as having produced perhaps more far-reaching results than any other station, and it is certain that orchard development and practice in the state and elsewhere are using these findings and profiting by them. That the improved pruning practices based upon station results have influenced the apple production by a five percent increase annually seems certain. On the apple crop alone, over six million boxes in 1921, this would mean approximately \$300,000.

Fertility Investigations Add to Profits

The Oregon Station too has been a leader in problems of orchard fertility. Some six or more years ago orchardists were groping in the dark for information, while their soils were being depleted and fruit production was falling off. Well-informed individuals estimate that orchard production in the Hood River district would not have been more than 60 percent of what it was in 1921 had the old methods been continued instead of the new practices based upon station findings and advice, especially for building up and maintaining orchard fertility. On this basis the difference means a net gain of about \$700,000.00 from the crop of 2,146,940 boxes in 1921.

Experiments carried on with old devitalized prune trees in several different parts of the state have shown that moderate amounts of nitrate of soda have increased the production about 25 percent, on the average, and lengthened the life of the tree appreciably. Information available indicates that these results have been followed on enough acreage to mean a gain of about \$17,000 in 1921.

The increased production of raspberries and loganberries following applications of fertilizers, such as nitrate of soda, at the rate of 250 pounds per acre, has been around 10 percent on the average. Fully 10 percent of the growers in the state have availed themselves of this information, and it is safe to estimate a net saving to the state of \$7,000.

Station Helped Start Juice Industry

Perhaps it cannot be said definitely that the Experiment Station is responsible for the loganberry juice production of the state. It is certain, however, that the fruit juice industry was given its initial start and a wonderful impetus through the experimental work begun by the Oregon Station in 1913.

Cherry Pollination Important

During 1911, 1912, and 1913 station experiments showed that the three leading sweet cherries of the state are not only self-sterile but intersterile,

—a startling fact, according to general knowledge at that time. Recommendations were made to top work about 11 percent of the trees in commercial orchards to cherries suitable as pollinizers for the commercial species. The information available indicates that only about five percent of growers have taken advantage of this suggestion. The increase in wealth from even this small application of station results is probably about \$72,000.

Branch Station Indispensable to Fruit Industry

The work of the Branch Experiment Station at Talent, Oregon, is known favorably throughout the country for what has been accomplished on problems of pear production and orchard fertilizers for apples, pears, and peaches. The experimental facts, and the consequent recommendations from the Station mean probably at least 100 cars increase in fruit in a year, worth \$100,000. Here again, however, it is difficult to place a valuation tag on the Station, further than to say that it is indispensably a part of fruit production and agriculture in Southern Oregon.

VEGETABLE GARDENING HELPED BY EXPERIMENTS

It is estimated that field tests for the comparative value of different strains of broccoli may be worth during this year to the growers of the state fully \$25,000. Experimental work done in pollinating greenhouse tomatoes resulted last year in a saving to the growers of approximately \$7,500. Experiments in growing greenhouse crops under better methods of management and with improved rotations have resulted in a benefit annually to men engaged in this work of approximately \$3,000.

Codling-Moth Control Means Annual Gain of Nearly Half Million Dollars

More than twenty years ago the codling-moth was recognized as a serious pest in Oregon, reducing the commercial output of apples by "at least a thousand car-loads" and causing, in spite of the control measures then in vogue, an average annual loss for the state estimated at 40 percent of the crop.

Investigational work was begun, and with the publication of Station Bulletin 69 in 1902, and continuing through the years, the Oregon Experiment Station has been instrumental in the development of (1) The late cover sprays in codling-moth control; which have increased the effectiveness of our control by from 18 to 80 percent. (2) Laws regarding the relation of temperature to the egg-laying habits of the moth, permitting the more intelligent timing of the cover spray for the first brood worms. (3) Combination sprays, using in the one-spray solution materials for combating both worms and disease. This has permitted a material reduction in the number of applications otherwise necessary for effective disease and pest control with a minimum of spray injury. (4) Development of Spray calendars, permitting the intelligent application of the sprays and thus obtaining maximum efficiency from the spray applications. (5) Insecticide studies, resulting in the general adoption of high-grade materials, properly applied at the advisable dosage.

The value of this work to the State of Oregon is probably best illustrated by the figures of the Hood River Station as follows: In 1913 with-

out organized assistance the loss from codling-moth was twelve percent. The Station has worked out and recommended each year a spray program which has reduced the average annual loss for five years to not over four percent—a saving of eight percent of fruit. In 1921 the average loss was about five percent and the saving seven percent compared with 1913 losses.

7% of 2,146,940 boxes or 150,285 boxes at \$1.40	\$210,399.00
Cost of extra spraying	50,000.00
Cost of harvesting increase at .40 per box	60,114.00

Net value from application of station results	100,285.00
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Equally accurate figures for the rest of the state are not available, nor is it probable that a correspondingly high percentage of growers follow the station findings. A conservative estimate of the value of the station findings, exclusive of the Hood River Valley, in improved worm control on the 1921 crop is \$300,000.00, making a total value of station findings and recommendations on codling-moth control to the 1921 fruit crop of \$400,285.00.

Control of Orchard Plant Lice Nets Large Gains

The brown, green, and woolly aphids of apple were causing serious losses to fruit as early as 1908. The control practices then followed involved several spray applications and at best were but partly effective. The Oregon Experiment Station developed in 1912 the "Delayed Dormant" spray application for orchard plant-lice control. Where formerly from two to five sprays were necessary and the injury ranged from five to thirty percent, through the station findings it was possible to reduce the number of applications generally to a single spray and to increase the effectiveness by at least five percent.

For the Hood River Valley in 1921 this would mean:

5% of 2,146,940 boxes or 107,347 boxes at \$1.40	\$150,285.80
Cost of control	50,000.00
Cost of harvesting investigations	42,938.80

Net value of station results	57,347.00
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For the state exclusive of the Hood River Valley a conservative estimate of the value of the station findings in reduced number of applications and improved control to the 1921 crop is \$170,000.00, making a total value of Station findings and recommendations on Aphis control to the 1921 fruit crop of over \$200,000.00.

Leaf Roller Losses Reduced

First developed as a serious pest in the Hood River Valley in 1911, leaf roller has caused serious losses in the Grande Ronde Valley since 1915. While still causing losses in these areas and increasing to a limited degree in other sections of the state, it is estimated that unhampered this insect would have caused a loss of 25 percent of the crop over an area producing 300,000 boxes. The oil sprays as tested out and recommended by the Hood River Experiment Station have reduced this loss to about 10 percent.

The saving in 1921 was 15% of 300,000 boxes or 45,000 boxes at \$1.40	\$ 63,000.00
Cost of spraying and special care	14,810.00
Cost of harvesting increase	18,000.00

Net value of station results	30,190.00
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Fig. 13. Without modern methods developed by experimental work for controlling diseases and insect pests commercial apple and pear production would be impossible.

Insecticide Investigations Save on Sprays and Spraying

In conjunction with and applicable to many of our other problems and pests, but of direct value to the growers, are the exhaustive studies of poison insecticides, spray solutions, their combinations and applications. For example: Oregon uses about 750,000 pounds of arsenate of lead annually. The average cost to the grower is 18 cents per pound; thus Oregon spends \$135,000 for arsenate.

By station findings that the powder is superior to the paste form of lead, our growers have been saved from three to seven cents a pound on lead arsenate, or \$20,000.00 annually.

By poison tests for toxic efficiency the Station determined that two pounds of lead arsenate to 100 gallons of water gave satisfactory toxic efficiency, reducing the amount of lead used by at least one-fifth or 100,000 pounds valued at \$18,000.00.

It costs approximately \$1.30 to \$1.70 per acre to apply a spray. By extended studies of compatible combination sprays it has been possible to reduce the number of spray applications by from one to four. There are about 48,000 acres of bearing apple and pear orchards in the state; these findings would reduce the cost of pest control by \$50,000.

More intangible but equally valuable are the results of investigations on spray injuries and improved spray application. Under the unusually moist climatic conditions of Western Oregon and Washington, excessive spray injury is liable to occur with materials apparently 100 percent safe in the East. In years gone by, reports of serious fruit drop or defoliation of orchards were fairly common. Today, even under the most unusual stress of unfavorable climatic factors, reports of serious spray injury are extremely rare.

Horticultural Insect Investigations Also Save Money

The Oregon Station has conducted or has under way studies on the life-history and control of Prune root-borer, Shot-hole borer, Peach twig miner, Bud moth, San Jose Scale, Bud weevils, Tussock moths, Red Spider mites, Cherry fruit maggot, Blister mites, Strawberry root-weevils, Loganberry crown-borer, Tree crickets, Syneta leaf-beetle, Pear and cherry slug, Currant and gooseberry maggot. The estimated value to 1921 crops is \$30,000.

Big Gains Follow Control of Field, Truck, and Garden Insects

A number of important control investigations of field and truck crop insects have been made. Of particular value are the investigations on the control of the grasshopper and the garden slug. The total value of these investigations in lessening crop losses is yet to be realized because of the failure, to date, of the general adoption of the improved control practices as developed. As an example of the possibilities in grasshopper control may be cited the campaign put on in Harney county. Losses from grasshoppers estimated at \$500,000 annually had occurred over a period of years. In 1918 at a cost to the county of \$2000 the losses were reduced 80 percent or to \$100,000. In 1919, as a result of a follow-up campaign costing the county \$6,000, commercial losses were practically nil or there was saved in crop values \$500,000. This at a cost to the county of \$8,000.00 for the biennium.



Fig. 14. A. Peach tree practically girdled by continual attacks of root borers. B. Adult moth, at rest. C. Eggs on prune bark (magnified). D. Larva (enlarged). E. Larva in winter cell (enlarged). Control of this pest will mean hundreds of thousands of dollars to Oregon's prune and peach industries.

Investigations have been made or are under way on the life-history and control of the Root-maggots of cabbage and radish, onions, and potatoes; cabbage worms, cutworms, corn earworm, *Diabrotica* bean beetles, flea beetles, garden thrips, and symphylids.

Station findings relative to control of these pests were worth probably \$20,000 in 1921 crop production.

The Station Wins Long Fight on Apple Scab

Probably the most important benefits to the state from the standpoint of fruit disease control have resulted from nearly twenty years' experiments by the Central Station and Hood River Branch Station on the prevention of apple scab. On account of the cool, moist spring conditions prevailing as a rule in the Hood River and Western Oregon fruit districts, it is common, in bad seasons, to find seventy-five to one-hundred percent of the fruit in unsprayed orchards attacked by this disease.

In 1903, in response to a request by the State Horticultural Society, the Station began a long series of spray investigations on scab control. These studies have not only given to the state a program of sprays (the delayed dormant application being worthy of special note) which have made possible the production of a very high percentage of scab-free fruit, even in the worst scab years, but they have also done away with the serious fruit russetting formerly caused by the universal use of bordeaux mixture through the discovery of the value of lime-sulfur in scab control, a discovery which has revolutionized orchard spraying in all parts of the world. In addition the Station has aided in the standardization of the lime-sulfur spray and also by its work has repeatedly protected the growers against the general use of ineffective or harmful spray materials placed on the market.

An appreciation of the meaning of these results to Oregon horticulture may be gained from the fact that in 1921, as a result of the use of station methods and in spite of the failure of a large number of growers to follow station recommendations accurately, not less than fifty percent or \$150,000 was added to the value of the boxed apple crop of the Willamette and Umpqua Valleys (estimated at \$300,000 total value) while in the Hood River Valley the grade of apples was so improved as to add about seventy cents a box to the selling value on fifteen percent of the crop of 2,146,940 boxes or \$225,428.00. Allowing \$10,000 for special spraying costs in the Willamette and Umpqua Valleys and \$82,000 in the Hood River Valley, the net saving to these sections alone in 1921 amounted to a total of \$285,428.00.

And Conquers Apple-Tree Anthracnose

The conquest of apple-tree anthracnose and fruit rot is another achievement of the Station which has meant much to Oregon horticulture. An orchard survey conducted more than twenty-five years ago showed the prevalence and severity of the disease in Western Oregon. Shortly thereafter the Station began extended investigations which not only established the nature of the disease but also resulted in the discovery that a covering of bordeaux spray present on the tree before the onset of fall rains would successfully prevent infections. Had apple growers not had the advantage of information from the Station based on this work, many of the best apple orchards of the Umpqua, Willamette, and Hood River valleys would

already have fallen into complete ruin from anthracnose attacks. In these districts the bearing orchards alone now cover more than 20,000 acres on which the trees may be conservatively valued at an average of \$350 per acre or more than \$7,000,000 in all. By the use of the station spray program, deterioration of at least five to ten percent in tree value, without considering the losses from fruit rot, was prevented in 1921, a saving for the growers of the state of \$350,000 to \$700,000.

Peach Blight Can Be Controlled

Some of the station results have as yet been taken advantage of by only a few growers. For example, investigations begun in 1907 demonstrated the success of early fall bordeaux applications for the control of the destructive peach blight and fruit spot fungus, while investigations conducted from 1916 to 1918 showed the advantages of a winter application of the same material for peach-leaf curl control. In spite of the simplicity of the methods worked out, the majority of Oregon peach orchards are still suffering from neglect or improper spraying. As a result, the gain from proper spraying in 1921 can be estimated at only about \$25,000, approximately one-fourth of the value of the light crop of that year.

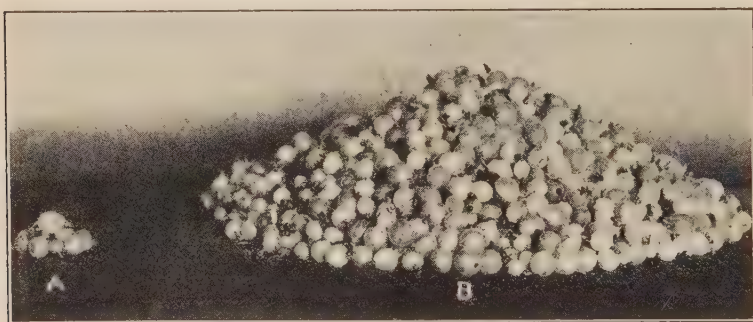


Fig. 15. Gooseberries from one bush sprayed with lime-sulfur. Clean fruit on the right and mildewed fruit on the left. Every berry on neighboring unsprayed bushes was mildewed. This method of control for mildew means the difference between a commercial crop and a worthless one.

Gooseberry Mildew Yields to Spray

The discovery in 1916 and 1917 that lime-sulfur used in the early spring would prevent the destructive effects of mildew on the common gooseberry varieties grown in the state, has been made use of thus far in only a limited way by the growers.

Onion Smut Yields to Formaldehyde Drip

Only a few onion growers have as yet adopted the formaldehyde drip method of onion smut control, which the Station in three years of work has demonstrated to be thoroughly effective in controlling this disease, which had already caused the abandonment, in certain parts of Oregon, of valuable onion land.

Mazzard Stock Prevents Cherry Gummosis

Among the other station results not fully utilized as yet by Oregon growers may be mentioned the establishment by five years' work of the

fact that gummosis of the sweet cherry may be largely prevented by the use of the Mazzard seedling for body stock in planting the orchard, although growers are adopting this precaution in increasing measure.

Potato Diseases Controlled by Three Methods

Five years of station work on potato diseases has laid a foundation for a permanently profitable potato production in Oregon by demonstrating that most of the serious potato diseases prevalent in the state are seed borne and soil borne and can best be controlled by three methods, all of which are of utmost importance: (1) rotation of soil, (2) field inspection of the seed plot and removal of diseased plants during the growing season, and (3) seed treatment. The Station also paved the way for potato seed



Fig. 16. Soft, slimy field-rot of tuber produced by a plant affected with blackleg. Control of this and other serious potato diseases is under investigation.

certification. A good many growers are already reaping the benefit of the application of station results to potato-disease control and the number is increasing annually; but there is still large opportunity for improvement in the general practice, with consequent gain in profits from this important crop.

POULTRY PRODUCTION GREATLY ASSISTED BY STATION

The average annual egg production for Oregon in 1909 was about 75 eggs per hen. In 1921 it was estimated at 100 eggs or over, an increase of fully one-third in production.

In 1908 the Experiment Station began poultry breeding experiments to increase egg production. The production of the station flocks was increased 100 percent by 1920, with flocks averaging around 200 eggs and individuals over 300 eggs.

Thousands of eggs and hundreds of male birds have been distributed throughout the state from these high laying strains. The station results have not only given the high-laying strains but have given an ideal and



Fig. 17. K-24, world's record Barred Plymouth Rock hen. Laid 324 eggs in first 365 days of production. Record made at California Farm Bureau Egg-Laying Contest at Santa Cruz, from December 14, 1920, to December 13, 1921. Bred and owned by the Oregon Agricultural Experiment Station.



Fig. 18. Pen 4 of Oregons, 1914-15. Record 250.2 eggs. All daughters of C-521, the first 300-egg hen.

an impetus which have done much to bring about the great increase in volume of production as well as the average increase of 33 percent in the number of eggs per hen.

The poultry products of 1921, at the low prices, were estimated at approximately \$10,000,000 value. It is confidently believed that the station work has meant at least \$1,000,000 in producing these \$10,000,000 of products. Further, the results from the Oregon Station are known and profited by the world over.

ASSISTANCE RENDERED THE HOG INDUSTRY

The Oregon Experiment Station has determined the value of nearly all of the more common hog feeds and is thereby able to give the farmer information which will enable him to feed his hogs most economically under any given conditions. We have determined quite accurately the comparative values, the amount of pork which we can produce, and the best methods of feeding, such products as barley, wheat, corn, shorts, middlings, oats, hulled oats, molasses, cocoanut meal, potatoes, corn silage, root crops, skim milk, buttermilk, whey, cabbage, fish meal, and



Fig. 19. Experiment Station hogs, fattened on barley and alfalfa pasture, Eastern Oregon Branch Station, Union.

such pastures as clover, rape and clover, drilled rape, wheat, rye, rye grass, vetch. These results have mostly been published in our bulletins and in condensed form on a little post card entitled, "Comparative Values of Pig Feeds."

In an industry so sensitive to over-production or under-production as the pig industry, the value of the accurate data of the Experiment Station becomes apparent. It is our judgment that the general spread of information on pig feeding such as has been demonstrated by the Experiment Station has changed methods in Oregon quite materially during the past ten years and that the methods now in vogue are at least ten percent more efficient than those of ten years ago. This would mean on a five million dollar output a saving of \$500,000. It is our judgment that on the basis of present knowledge there is a possible five percent, or \$250,000, further improvement. Similar data, though not so complete, are available for beef cattle and sheep.

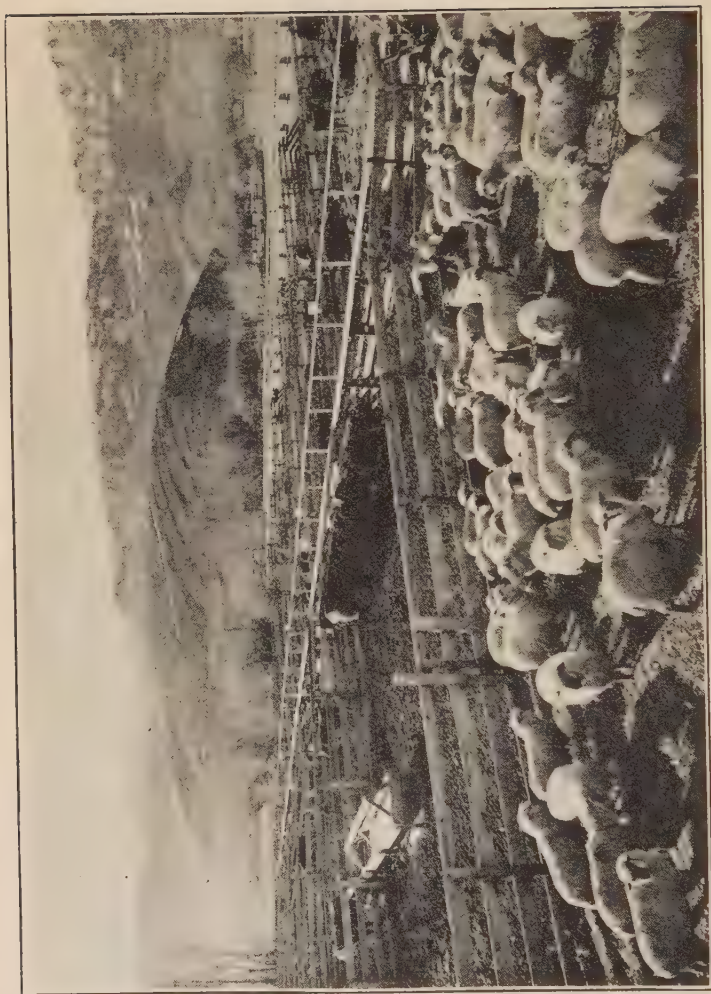


Fig. 20. Sheep and cattle in feeding experiments at the Union Station. Present-day practice in fattening stock is based upon experimental feeding tests of such stations over many years.

RECENT STATION ACCOMPLISHMENTS MEAN THOUSANDS OF DOLLARS TO OREGON AGRICULTURE

FEDERATION WHEATS MEAN INCREASED YIELDS

In a four-year trial, Hard Federation and Federation, two wheats selected from Australian wheat varieties, have out-yielded Early Baart by more than 20 percent; and Early Baart had previously replaced Pacific Bluestem, upon recommendation of the Moro Station, because it had proved to be the highest yielder in the station experiments. Trials made by farmers in 1921 indicate that both of these new Federation wheats will be suited to practically all of Eastern Oregon. The Federation has also proved to be a high yielding variety under irrigation. Both varieties have been widely distributed to farmers in every Eastern Oregon county and results confirm the results of station trials that these varieties will soon be important commercial wheats.

A ten-percent increase in spring wheat yield in Eastern Oregon would exceed 297,000 bushels annually.

SMUT-RESISTANT WHEATS DISCOVERED

A few pure-line selections of wheat varieties were discovered that are totally immune to both species of stinking smut. The discovery of these wheat varieties is likely to prove of much economic importance to the wheat growing industry of Oregon and will probably mean the eventual elimination of the stinking smut nuisance from the state. This would mean an annual saving of several hundred thousands of dollars to Oregon farmers alone. Thus far the immune varieties are not equal in yield to the leading commercial wheats grown. Notwithstanding this fact, the progress made and the possibilities are considered of outstanding importance. •

HUNGARIAN VETCH DISTRIBUTED

About sixty acres of Hungarian vetch planted in the fall of 1921 will be harvested for seed and the seed distributed to farmers of Western Oregon in 1922. In trials over a number of years this vetch has proved of outstanding value. It is not only suited to wet, unfavorable conditions, but is also a better yielder for hay, silage, and seed, than other vetches. It shatters seed less readily than most of the other vetches; is more resistant to attack from aphids, and is a very good bee plant. In fact, Hungarian vetch is believed to be the most valuable development for Western Oregon in the forage crop line in years.

INVESTIGATIONS HELP THE DAIRY INDUSTRY

Appropriations for investigation of dairy-industry problems have been available only during the past few years. The problems need study for many years before definite practical solution is reached. The effort is imperative, however, as diseases alone are costing the dairymen two to three million dollars a year.

An intensive study of infectious abortion is under way. The methods of spread of the disease have been worked out and new field experiments in controlling and eradicating the disease are apparently giving results. The outlook is promising for something practical in the way of control.

Studies of sterility in cattle have resulted in devising methods of treating these troubles with success in about 50 percent of the cases. These methods have been demonstrated to veterinarians of Oregon, Washington, British Columbia, Idaho, and Montana. Hundreds of cattle are being treated each year. In Oregon the gain annually from this work already means at least \$5,000.

NEW RECORD MADE FOR BARRED ROCKS

A new laying record for Barred Rocks was made during 1921 when the station Barred Rock hen K 24, completed her first year with 324 eggs at a laying contest in California. Further, this hen has not stopped laying for longer than seven days to date, July 1, 1922, since she began December 14, 1920, and in this period has laid 443 eggs in 562 days, an average of 78.8 percent production. Sixty-three eggs set for hatching in 1922, produced after about 14 months laying, showed fertility of 95 percent. More than for the record itself, this accomplishment is a measure of successful effort in the station breeding work to produce strains for high laying over a long period and with the vigor necessary to maintain such effort.

CONSTRUCTING DEEP DRAINS BY SLUICING

The development of sluicing as a method of constructing deep drains, worked out in cooperation with local people of Malheur Valley, is of great importance in cheapening and advancing much-needed drainage and reclamation in that section, and in other sections with similar conditions. The first drain, 12 feet deep and about 1,000 feet long, was constructed by sluicing at a cost of approximately 17 cents per foot of drain, in connection with an experiment to drain and reclaim alkali land. Following this beginning in 1921, there has been constructed one drain 2226 feet long and 12 feet deep at a cost of 11 cents per foot of drain. On another drainage unit, one mile of ditch has been completed and another half mile is nearly completed. An additional three and one-half miles are ready for sluicing. This district, requiring about six miles of drains, will be completed at a cost of about \$15,000 as compared with the previous engineering estimate of \$40,000. The directors of this drainage unit estimate a saving of \$25,000 on the one unit alone from this finding.

NEW METHOD WORKED OUT FOR CLEARING THE BIG STUMP LAND

The new method of removing stumps 24 inches and over in diameter, originated by Mr. S. F. Zysset and developed by the Experiment Station in cooperation with Mr. Zysset, is simple, practical, and of outstanding merit, reducing the cost of clearing the average big stump land fully fifty percent over previous methods.

WHAT WOULD BE THE SITUATION OF THE STATE IF IT DID NOT MAINTAIN THE EXPERIMENT STATION?

It is most difficult always to place a value on a catastrophe prevented. There are, however, certain definite reasons why the state would be in an unenviable position if the Experiment Station were not maintained.

MUCH SERVICE WOULD BE LOST

1. Much of the service which is responsible for the items making up the \$5,000,000 value of station work reported for 1921 would be less effective. For example, experience and results have demonstrated very marked increase in effectiveness of pest control from having trained men to direct practice as is done over the small area covered by the Hood River Station. Conditions of weather and pest attack differ enough from year to year so that direction by trained men pays many times over.

PROMISING DISCOVERIES WOULD BE DELAYED

2. Many valuable discoveries which now seem probable as the result of years of experimentation, would be lost if the Station was discontinued or its support reduced to any extent. One example is the near possibility of blight-resistant pear stocks, apparently assured but needing further test and development of ways to increase the stock for commercial use. This discovery, perfected, will mean millions to the state and nation. Another example is the possibility of wheats resistant to smut. There is reason to believe this accomplishment will be realized within a few years from the developments to date. Oregon farmers spend annually perhaps \$250,000 or more for materials for smut treatment. And in addition, there is much loss from poor stands of grain, reseeding, and reduction in yield and quality.

CALLS FOR HELP COULD NOT BE ANSWERED

3. There would be no agency to undertake solution of troublesome problems now before the farmers or others which will come in greater numbers with age and greater intensiveness of agriculture. As examples, attention is called to diseases of dairy cattle and to the following resolutions and calls for assistance which have recently come to the Director's office:

a. Infectious abortion and related diseases are causing losses of 3,000,000 or more, mainly to the dairy industry, in Oregon annually.

b. The following resolution was received on February 27, 1922:

"Recognizing the large importance of the prune industry in Oregon, and

"Recognizing that more than 90 percent of our vast prune crop is dried on or in the vicinity of the ranches where grown, and

"Realizing that prune growers are suffering a heavy annual loss running up into the hundreds of thousands, if not millions, because of inefficient drying practice, and further

"Realizing that at the present time we have literally hundreds of different types and variations of driers used in the state.

"We the members and executive board of the Douglas County Farm Bureau and representative agriculturists do earnestly recommend to our State Experiment Station that experimental work to determine the best type of drier and method of drying be given all possible impetus and that appropriations and energy be provided which shall be commensurate with the importance of this question to the fruit industry of our County and State.

"(Signed) R. A. HENCHER

"President Douglas County Farm Bureau."

PEOPLE WANT THESE PROBLEMS STUDIED

c. Other similar resolutions or urgent requests recently received call for much needed assistance:

(1) In finding or developing legumes to take the place of alfalfa in areas infested with alfalfa weevil.

(2) In working out ways of protecting the cranberry industry against diseases and pests which seriously threaten its economic existence.

(3) In finding the causes and a preventive of a disease which is interfering greatly with effective shipment of broccoli and will, if not solved, prevent expansion of the industry.

(4) Assistance in determining the value of coast lands for blueberry culture. The possibilities are undoubtedly great, but the crop is exacting as to soil and methods of growing and reproduction. Attempts thus far have not been marked by economic success.

(5) Assistance in reclamation of logged-off lands. After years the Station has cooperated in the development of a new method of burning stumps which has promise of success.

(6) Assistance in developing agriculture in the area near Fort Rock where the state has drilled wells which appear to give hope of development by pumping and irrigation.

The examples given are just a few problems for which immediate assistance has been requested. There are many other unsolved problems of equal or greater importance not under study at present.

OTHER PROBLEMS NEED INVESTIGATION

During the readjustment of farming practices the past two years there has been much need of reliable facts regarding farm organization and combinations of farm enterprises suitable for diversified farming, under different conditions of the state. A similar need has been apparent for cost of production data to aid in readjustment to changing market and labor conditions and to diversified farming. These are matters upon which opinions are many but actual reliable facts few.

There is growing need for systematic study of marketing of products of Oregon agriculture. The problems of this field are of such nature that thorough study only can accomplish results in keeping with the magnitude and complexity of the problems.

While the station results mean much in the growing of farm crops, there is still great need, as well as possibility, for developing forage crops and grains better suited to the soils, climate, and disease conditions in many sections of the state. The time and manner of working the soil and the time and way of planting crops have much to do with securing the extra yield which means success. Our present information and practice are far short of the improvement needed.

Likewise, there is need for more thorough study of crop rotation systems over a period of years for progress in keeping farm lands permanently productive under changing systems of farming, which must come with changing conditions of markets, crop pests, fertilizers, labor, and machinery.

The problems of weed control and pasture development are of increasing importance. So are the problems in standardization of crops to keep pace with new marketing requirements.

Only a few of the soil fertility problems and possibilities have been studied. Drainage should eventually reclaim about 3,000,000 acres of land in Oregon, and our knowledge of reclamation by drainage and the improvement of drained lands is yet limited. Likewise, there are many problems

in the proper use of water to make the best use of water which has been provided for irrigation at great expense.

Small fruits in Oregon have increased from 5,122 acres in 1909 to 13,652 acres in 1921. The crop value in 1921 was estimated at \$3,378,000. The industry as a whole and each crop represents highly specialized agriculture with many problems of cultural practice, breeding for better varieties, soil fertility, the development of new areas and protection against diseases and pests, of which there are many.

Only limited study has been given to questions of soil fertility and irrigation in the maintenance and productiveness of Oregon's orchards. The possibilities of improvement are estimated at \$1,000,000 a year or more on the large area in commercial orchards.

Walnut blight, for which no practical control methods are known, causes a loss estimated at \$30,000 annually. Filbert bacteriosis causes a loss of about ten percent in two- and three-year-old plantings.

Oregon has about 100,000 colonies of bees. The bee industry suffers a considerable loss annually from diseases and lack of information on winter care.

The poultry industry has to contend with heavy losses annually from disease, and there is much need of more reliable information on feeds and feeding for continued development of this important industry.

TEACHING AND EXTENSION WILL BE HANDICAPPED WITHOUT THE STATION

(4) Unless the information, new crops, new methods are developed through study and experimentation to meet changing conditions and new problems in agriculture, both teaching and extension will be limited in accomplishment in agriculture.

(5) The Station acts as technical adviser to the State Board of Horticulture in matters of quarantine and cooperation with other states in control of crop pests.

(6) The Station administers laws passed by the state for protection of farmers.

These citations are examples only. They are not a complete statement. Such a statement would include no less than 50 demands or opportunities for effective service, neglect of which will cost the state ten to one hundred times more than the Experiment Station costs.

IS OREGON ABREAST OF OTHER STATES IN FUNDS AND EXPENDITURES FOR EXPERIMENT STATION WORK?

Information available indicates that Oregon is financed about equal to the average. Figures published for 1919 show an average per state of about \$142,816. Recent information shows an average increase of a little over \$11,000 per annum for the biennium 1920-22 for 43 states reported, making a probable average of about \$164,818. If Oregon's estimated receipts materialize for all stations in the fiscal year ending June 30, 1922, the total as given will be slightly below the average.

In about one-fourth of the states, however, the appropriations are small. Compared with California, Illinois, Minnesota, Mississippi, and

Texas, Oregon's finances are about one-half. Oregon is financed about the same as Utah, Idaho, Montana, and Washington.

Oregon's main difficulty lies in great diversity and the necessity of maintaining seven branch stations. This leaves only about one-half the funds most stations have for problems which are largely statewide, such as control of plant diseases and insects, animal diseases, problems of dairying, poultry diseases, farm crops, farm management and cost of production, and marketing. The demands of highly specialized industries such as fruit growing and the legislative restrictions have necessitated concentration on problems of fruit growing and a few other, and upon general, immediate service in support of extension, in assisting with emergency problems of crop protection, and calls by 20,000 or more letters annually. In these fields, Oregon Station work is recognized as second to very few.

The question that must be faced is whether to let the other growing industries, with many peculiar troubles, shift for themselves. The losses and the opportunities would argue against it, at such time as the state can reasonably give assistance. Few stations are so poorly equipped with land and greenhouse facilities as the main Station of Oregon.

THE NATIONAL AGRICULTURAL CONFERENCE URGES SUPPORT OF STATIONS

The following statement is quoted from a resolution passed unanimously by the recent National Agricultural Conference made up of farmers, business men, and agriculturists:

"The greatest disaster which can come upon a people is the retardation of the development and diffusion of knowledge. America leads in all phases of National life because it has always led in efforts to discover and disseminate knowledge among all the people. This applies with special force to all matters concerning agriculture.

"The new agricultural problems which have come as a result of post-war conditions require early solution. The individual farmer is demanding information. As never before he is now entering the business world through his cooperative organizations.

"Existing institutions for agricultural research, education, and extension should be developed and strengthened. There should certainly be no reduction in financial support."

The foregoing was in spite of the fact that the same body went on record to the effect that any and all appropriations be given the "acid test." Among those most closely in touch with the growing complexity of agriculture, the difficulties of eliminating or controlling hazards, and the great accomplishments from better plants and improved methods, there is a growing feeling that the experimentation and organized assistance such as is represented by the agricultural experiment stations must be considered as an investment, a part of the plant as it is in industry, not as a contribution, or luxury to be dispensed with readily. The more trying agricultural conditions are, the greater is the call upon the station organization. This fact is true today in Oregon, and its importance must not be overlooked in view of the need for settlers. The states from which new farmers will most probably come maintain larger stations than Oregon does, and farmers rely on them. Not to find such agencies at their command in Oregon would do much to divert many settlers to other places.

